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Goodnews River Salmon Monitoring and Assessment, 2011

Annual Report for Project OSM 10-300
USFWS Office of Subsistence Management
Fisheries Resource Monitoring Program

by

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and

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Alaska Department of Fish and Game **Divisions of Sport Fish and Commercial Fisheries**

Symbols and Abbreviations

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Weights and measures (metric)

centimeter	cm
deciliter	dL
gram	g
hectare	ha
kilogram	kg
kilometer	km
liter	L
meter	m
milliliter	mL
millimeter	mm

Weights and measures (English)

cubic feet per second	ft^3/s
foot	ft
gallon	gal
inch	in
mile	mi
nautical mile	nmi
ounce	oz
pound	lb
quart	qt
yard	yd

Time and temperature

day	d
degrees Celsius	°C
degrees Fahrenheit	°F
degrees kelvin	K
hour	h
minute	min
second	s

Physics and chemistry

all atomic symbols	
alternating current	AC
ampere	A
calorie	cal
direct current	DC
hertz	Hz
horsepower	hp
hydrogen ion activity (negative log of)	pH
parts per million	ppm
parts per thousand	ppt, ‰
volts	V
watts	W

General

Alaska Administrative Code	AAC
all commonly accepted abbreviations	e.g., Mr., Mrs., AM, PM, etc.
all commonly accepted professional titles	e.g., Dr., Ph.D., R.N., etc.
at	@
compass directions:	
east	E
north	N
south	S
west	W
copyright	©
corporate suffixes:	
Company	Co.
Corporation	Corp.
Incorporated	Inc.
Limited	Ltd.
District of Columbia	D.C.
et alii (and others)	et al.
et cetera (and so forth)	etc.
exempli gratia (for example)	e.g.
Federal Information Code	FIC
id est (that is)	i.e.
latitude or longitude	lat. or long.
monetary symbols (U.S.)	$, ¢
months (tables and figures): first three letters	Jan,...,Dec
registered trademark	®
trademark	™
United States (adjective)	U.S.
United States of America (noun)	USA
U.S.C.	United States Code
U.S. state	use two-letter abbreviations (e.g., AK, WA)

Mathematics, statistics

all standard mathematical signs, symbols and abbreviations	
alternate hypothesis	H_A
base of natural logarithm	e
catch per unit effort	CPUE
coefficient of variation	CV
common test statistics	(F, t, χ^2, etc.)
confidence interval	CI
correlation coefficient (multiple)	R
correlation coefficient (simple)	r
covariance	cov
degree (angular)	°
degrees of freedom	df
expected value	E
greater than	>
greater than or equal to	≥
harvest per unit effort	HPUE
less than	<
less than or equal to	≤
logarithm (natural)	ln
logarithm (base 10)	log
logarithm (specify base)	$\log_2$, etc.
minute (angular)	'
not significant	NS
null hypothesis	H_O
percent	%
probability	P
probability of a type I error (rejection of the null hypothesis when true)	α
probability of a type II error (acceptance of the null hypothesis when false)	β
second (angular)	"
standard deviation	SD
standard error	SE
variance	
population	Var
sample	var

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ABSTRACT

Goodnews River is the primary salmon spawning drainage in the Goodnews Bay area and supports subsistence, commercial, and sport fisheries near the communities of Goodnews Bay and Platinum in Southwest Alaska. The Alaska Department of Fish and Game, in cooperation with the U.S. Fish and Wildlife Service, operates a resistance board weir to enumerate fish returning to Middle Fork Goodnews River. In 2011, a total of 1,861 Chinook *Oncorhynchus tshawytscha*; 17,946 sockeye *O. nerka*; 19,974 chum *O. keta*; 1,394 pink *O. gorbuscha*; 23,826 coho salmon *O. kisutch*; and 3,667 Dolly Varden *Salvelinus malma* were estimated to have passed through the weir from 24 June through 18 September. The Chinook salmon escapement at the weir was within the biological escapement goal range. Sockeye salmon escapement was slightly below the biological escapement goal. Chum and coho salmon escapements were above their respective sustainable escapement goal lower bounds in 2011. However, escapements for Chinook, sockeye, chum, and coho salmon were below average.

Key words: Chinook, *Oncorhynchus tshawytscha*, chum, *O. keta*, coho *O. kisutch*, sockeye *O. nerka* and pink salmon, *O. gorbuscha,* Dolly Varden *Salvelinus malma,* escapement monitoring, Goodnews River, Kuskokwim Area, Kuskokwim Bay.

INTRODUCTION

Salmon returning to Goodnews River support subsistence, commercial, and sport fisheries near the community of Goodnews Bay in Southwest Alaska. The Alaska Department of Fish and Game (ADF&G), in cooperation with the U.S. Fish and Wildlife Service (USFWS) Togiak National Wildlife Refuge (TNWR) and Office of Subsistence Management (OSM) operates a resistance board weir to enumerate returning adult salmon, by species, on Middle Fork Goodnews River (Middle Fork) in an effort to manage the resource sustainably.

In Alaska, ADF&G is responsible for managing salmon fisheries in a manner consistent with the *Sustainable Salmon Fisheries Policy* (5 AAC 39.222). This task requires long-term monitoring projects that reliably measure annual escapement to key spawning systems as well as track temporal and spatial patterns in abundance that influence management decisions. Escapement goals are developed as a means to gauge escapement adequacy. The Goodnews River weir is utilized to assess escapements. ADF&G currently has escapement goals for Chinook *Oncorhynchus tshawytscha*, sockeye *O. nerka*, chum *O. keta*, and coho salmon *O. kisutch*.

SALMON FISHERIES

Goodnews River is the primary salmon spawning drainage in the area and provides a vital subsistence fishery resource for residents from the communities of Goodnews Bay and Platinum. Subsistence fishing is allowed throughout the Goodnews River drainage and in Goodnews Bay, which is primarily performed with drift and set gillnets. ADF&G has quantified subsistence salmon harvests in the communities of Goodnews Bay and Platinum since 1977. Harvest estimates are determined from interviews with subsistence fishermen in October and November. Sockeye salmon have been the most utilized subsistence salmon species in the Goodnews Bay area with a 10-year (2001–2010) average harvest of 1,203 fish, followed by coho salmon (826), Chinook salmon (824), and chum salmon (368) (Hamazaki 2011).

Commercial salmon fishing occurs in Goodnews Bay within the boundaries of District W-5, the southernmost district in the Kuskokwim Area (Figure 1). Commercial fishing has occurred annually in District W-5 since it was established by the Alaska Board of Fisheries in 1968. Permit holders have unrestricted movement between commercial fishing districts within the Kuskokwim Area and fishermen from distant communities often participate in the District W-5 commercial fishery. The commercial fishery is primarily directed toward harvesting sockeye and

coho salmon and is conducted from skiffs using hand-pulled gillnets. Pink salmon *O. gorbuscha* are the least valuable species commercially and have not been targeted in recent years. ADF&G has collected harvest data from fish buyers and processors since the district was created.

Since 1969, combined commercial harvests of salmon species in District W-5 have ranged from 2,879 in 1971 to 148,036 fish in 1994. Harvest numbers have been relatively stable since the late 1990s, with the exception of the low harvest in 2002 when market demand and processing capacity were low. The recent 10-year average harvest (2001–2010) was 51,724 salmon. Harvests efforts were high through the early 1990s when over 100 permits were fished annually. Harvest efforts have been relatively low in recent years with the recent 10-year average (2001–2010) of 32 permits fished annually (Brazil et al. 2011).

Sport fishing occurs throughout the Goodnews River drainage. Pacific salmon (primarily Chinook and coho), rainbow trout *O. mykiss*, Dolly Varden *Salvelinus malma*, Arctic char *S. alpinus*, lake trout *S. namaycush* and Arctic grayling *Thymallus arcticus* are targeted. Many sport fishermen take commercially guided or unguided float trips from lakes in the headwaters to the mouth at Goodnews Bay. There are currently 2 commercially operated lodges with semi-permanent camps in the drainage that offer fishing from powered skiffs. ADF&G has been estimating sport fishery harvests consistently since 1991. From 1999 to 2008 there was an average of 3,711 angler days annually. The average annual harvest for the same 10-year period, combining the five local species, was 890 salmon (Chythlook 2011).

PROJECT HISTORY

ADF&G, Division of Commercial Fisheries, has operated a salmon escapement monitoring project on Middle Fork Goodnews River since 1981 (Appendix A). The project was initiated as a counting tower in 1981 and operated through 1990 (Schultz 1982; Burkey 1990) focusing counts on Chinook, sockeye, and chum salmon. Although successful, the tower was limited by problems with species apportionment and high labor costs (Menard 1999). In 1991, resources were redirected towards a fixed-picket weir to reduce labor costs and improve species identification. The fixed-picket weir was operated from 1991 through midseason 1997, approximately 229 m downstream from the former tower site. Fish passage could be controlled, eliminating the need for hourly monitoring and increasing the efficiency of collecting age, sex, and length (ASL) information. Flood events were problematic if the weir could not be removed early in the season. The weir would rapidly collect debris, damming the flow until it failed and washed downstream, which occurred several times during the early 1990s.

In the mid-1990s, ADF&G began cooperating with USFWS to build a resistance board (floating) weir that would allow the project's operational period to include the coho salmon run during August and September. In July 1997, the resistance board weir was installed. This weir is designed to shed debris loads by sinking under high water conditions and allows the project to remain operational at higher water levels compared to the fixed-picket weir. The resistance board weir design can be rendered inoperable during extreme high water events; however, the weir can regain operations quickly once the high water subsides.

Extended operation of the weir has also allowed biologists to monitor the migration of Dolly Varden. Dolly Varden are anadromous and believed to be aggregates of mixed stocks of fish returning to spawn and other immature fish that intend to overwinter in the drainage (Lisac 2007). Dolly Varden contribute to the overall subsistence harvest of the residents of the Goodnews Bay area (Wolfe et al. 1984). However, quantitative information on actual subsistence

harvest is not available. The weir has provided run timing and abundance estimates for Dolly Varden since 1996 and was used as a platform for Dolly Varden life history studies from 2001 to 2009 (Lisac 2010).

In 2006, TNWR provided an underwater video monitoring system to the project. This system allows the passage chute to be open for more hours per day. The system is controlled by digital video recorder with motion sensing software which condenses the hours of fish passage into a shorter video stream.

ESCAPEMENT MONITORING AND ESCAPEMENT GOALS

The Middle Fork Goodnews River weir serves primarily as a management tool for commercial and subsistence salmon fisheries in the Goodnews Bay area. These data are used to make inseason management decisions based on both sustainable escapement goals (SEG) and biological escapement goals (BEG). The project also serves as a platform for other studies in the drainage, such as collecting samples for genetic stock identification and tagging Dolly Varden to study run timing and seasonal distribution (Lisac 2010).

Salmon escapement objectives for the Middle Fork counting tower were initially established in 1984 as ranges set at 3,000 to 4,000 Chinook; 35,000 to 45,000 sockeye; and 13,000 to 18,000 chum salmon (Schultz 1984). An escapement objective was not established for coho salmon as the project typically ceased operation in mid-August, well before the coho salmon run ends. In 1989, the escapement objective range for sockeye salmon was reduced to 20,000 to 30,000 fish. An evaluation of the sockeye salmon exploitation rate in previous years indicated that historical harvest levels could be maintained with a reduced escapement objective (Burkey 1990). These ranges remained in place when the tower was replaced with the fixed-picket weir in 1991.

In 1992, weir based SEGs were first established for Chinook, sockeye, and chum salmon (Buklis 1993). The respective SEGs were set as the midpoints of tower escapement objective ranges: 3,500 Chinook; 25,000 sockeye; and 15,000 chum salmon. In 2004, evaluation of Arctic-Yukon-Kuskokwim (AYK) Region escapement goals resulted in establishment of revised SEGs for the Middle Fork Goodnews River weir (ADF&G 2004). The revised goals, described as ranges or lower bounds, were 2,000 to 4,500 Chinook salmon; 23,000 to 58,000 sockeye salmon; and greater than 12,000 chum salmon. A lower bound SEG was also established for coho salmon at greater than 12,000. In 2007, evaluation of AYK Region escapement goals resulted in a revision of the Middle Fork Goodnews River weir Chinook and sockeye salmon escapement goals from SEGs to BEGs (Brannian et al. 2006). The BEG for Chinook salmon was set at 1,500 to 2,900 fish and the BEG for sockeye salmon was set at 18,000 to 40,000 fish. In 2009, evaluation of AYK Region escapement goals did not result in changes to escapement goals set for Goodnews River salmon (Estensen et al. 2009).

AGE, SEX, AND LENGTH COMPOSITION ESTIMATES

Salmon ASL information has been collected from the weir project since 1984. Historically, the dominant age classes for Chinook salmon are age-1.2, 1.3 and 1.4 fish. Sockeye salmon escapement is dominated by age-1.3 fish. Chum salmon dominate age class varies between age-0.3 and 0.4 fish. Age-2.1 fish are dominant for coho salmon. Chinook salmon male to female ratio varies with run timing, with males more dominate for the total run. Sex ratios are approximately 1 to 1 for sockeye, chum and coho salmon. Historical summaries of existing ASL

information for salmon returning to the Goodnews River drainage can be found in Molyneaux et al. (2010).

OBJECTIVES

Annual project objectives are to:

1. Estimate Chinook, sockeye, chum, coho salmon, and Dolly Varden escapement at the weir.
2. Estimate the run timing of Chinook, sockeye, chum, coho salmon, and Dolly Varden at the weir.
3. Estimate the ASL composition of annual Chinook, sockeye, chum, and coho salmon escapements, such that 95% simultaneous confidence intervals for the age composition have a maximum width of ±10% (α=0.05 and d=0.10).
4. Record atmospheric and hydrologic conditions at the weir site.

METHODS

SITE DESCRIPTION

The Goodnews River watershed drains an area of nearly 2,590 km^2 along the west side of TNWR (Figure 2). It flows a distance of 97 river kilometers (rkm) along its mainstem, from Ahklun Mountains southwest into Goodnews Bay. Two major tributaries, Middle Fork and South Fork Goodnews rivers, join the mainstem a few miles from its mouth and are included within its drainage. In order to differentiate between them, Goodnews River refers to all three drainages, and the mainstem Goodnews River upstream of its confluence with Middle Fork will be referred to as North Fork Goodnews River or North Fork.

Middle Fork Goodnews River parallels North Fork Goodnews River and flows a distance of approximately 72 rkm before joining the mainstem. The weir project is located approximately 16 rkm from the village of Goodnews Bay on the Middle Fork at lat. 59°09.595'N, long 161°23.287'W (Figure 1). The channel at the weir location is approximately 61.0 m wide, has a regular profile from 0.3 to 1.2 m deep, which tapers to low cut banks on either side and flows 0.6 to 1.2 $m \cdot s^{-1}$ during average water conditions. The river substrate is primarily cobblestone, gravel, and sand. The channel upstream of the weir is characterized by deep water along a steep cut bank approximately 6.1 m in height on the left bank (as looking downstream) tapering to a gravel bar on the right bank. The project campsite is located on the left bank approximately 46 m upstream and 27 m inland from the weir location.

RESISTANCE BOARD WEIR

Methods for the design, construction, and installation of the resistance board weir followed Tobin (1994) and Stewart (2002, 2003). The picket spacing allows smaller fish, such as pink salmon and other non-salmon species, to pass upstream and downstream through the weir. Further details of resistance board weir components used for the Goodnews River weir are described in Stewart (2004).

Two fish passage chutes were installed on the weir at approximately 15 m and 5 m from the south bank. A 3 m by 4.6 m trap used to collect fish for ASL sampling was installed directly upstream of the passage chute located furthest from the bank. The fish passage chute located

nearest to the bank was connected to a passage gate that incorporated an underwater video camera that recorded fish passage.

Boats passed at a designated boat gate consisting of modified weir panels located near the middle of the weir. Boats with jet-drive engines were common and could pass upstream and downstream over the boat gate easily at reduced speed. Rafts could pass downstream by submerging the boat passage panels and drifting over the weir. Boats with propeller-drive engines were uncommon and required being towed upstream across the weir with assistance from crew members.

ESCAPEMENT MONITORING AND ESTIMATES

The Middle Fork weir operated from 24 June through 18 September. Counting periods occurred regularly throughout the day, typically for 1–2 hour duration, beginning in the morning and continuing as late as light permitted. During counting periods the passage gate was opened to allow fish to pass through the weir. Counts were also conducted using underwater video equipment that allowed for continuous monitoring and was typically operated from 1000 hours to 2200 hours. Fish passage captured by the video equipment was reviewed by the crew and included in passage counts recorded as daily video total passage. Any fish observed traveling downstream through the fish passage chutes were subtracted from the tally.

AGE, SEX, AND LENGTH SAMPLING AND ESTIMATES

Sample sizes were calculated using Bromaghin (1993) and adjusted for a non-readable scale rate of 20%; such that sample sizes would produce simultaneous 95% confidence interval estimates of age composition ±10% for each age-sex category ($\alpha = 0.05$ and $d = 0.10$). The sample size for Chinook salmon was adjusted for a finite population based on the lower bound of the SEG. Sample sizes of sockeye and chum salmon were increased by a factor of 3 to allow for postseason stratification. The sample size objective for each species was 203 Chinook, 648 sockeye, 606 chum, and 202 coho salmon.

Daily sample objectives were based on a proportional sampling design and a preliminary population estimate based on the lower bound of the escapement goals for each species. Daily sample proportions were 0.14 for Chinook, 0.04 for sockeye, 0.05 for chum, and 0.02 for coho salmon. Therefore, the daily Chinook salmon sample size was 0.14 of the previous day's passage. Due to abundance of sockeye, chum, and coho salmon, samples were collected every few days and the sample size was the sum of the previous day's passage multiplied by the daily proportion. When daily sample objectives were not met, attempts were made to collect additional samples during the next opportunity. Ultimately, it was up to the crew leader to determine the appropriate sample schedule based on fish passage patterns and minimum sample size objectives as outlined above.

Salmon were sampled from a trap installed in the weir. To sample sockeye, chum, and coho salmon the exit gate was closed allowing fish entering the trap to accumulate inside. The trap was typically allowed to fill with fish and sampling was done during scheduled counting periods. Because of the relatively low proportion of Chinook salmon to other species, they were captured in the trap while allowing other species to pass during typical passage counts (active sampling).

For escapement sampling, scales were removed from the preferred area of the fish (INPFC 1963). A minimum of three scales were removed from each Chinook and coho salmon and one scale was removed from each chum and sockeye salmon. Scales were mounted on numbered and

labeled gum cards. Sex was determined by visually examining external morphology such as the development of the kype, roundness of the belly and the presence or absence of an ovipositor. Length was measured to the nearest millimeter from mideye to tail fork and the fish released upstream of the weir. After sampling was concluded, gum cards and data forms were completed and returned to the Bethel ADF&G office for processing.

ADF&G staff in Bethel and Anchorage aged scales, processed the ASL data, and generated data summaries as per Molyneaux et al. (2010). Samples are divided into three strata based on cumulative percent passage. Each stratum was then weighted by the number of fish passing in each stratum to estimate the overall age and sex composition. Age and sex confidence interval bounds were estimated to determine if the desired precision was met for the season estimate. If the desired precision level was met then season summary was the weighted estimate of the escapement. If the desired precision level was not met then the season summary was not applied to the escapement and only the composition of the samples was presented.

Ages are reported in the tables using European notation. European notation is composed of two numerals separated by a decimal, where the first numeral indicates the number of winters spent in fresh water and the second numeral indicates the number of winters spent in the ocean (Groot and Margolis 1991). Total age is equal to the sum of these two numerals plus one to account for the single winter of egg incubation in the gravel. Original ASL gum cards, acetates, and mark–sense forms are archived at the ADF&G office in Anchorage. Computer files were archived by ADF&G in the Anchorage and Bethel offices.

ATMOSPHERIC AND HYDROLOGICAL MONITORING

Atmospheric and hydrological conditions were recorded at 1000 each day. Cloud cover was judged in percent of total sky covered; wind speed was estimated in miles per hour and direction was noted; precipitation was measured in mm per 24 hours. Daily air and water temperatures were recorded in degrees Celsius. The river level was recorded daily and was referenced to a benchmark established in 1997 representing a river stage of 150 cm. The benchmark was an aluminum I-beam driven into the bank along a steep grade downstream of the field camp. The river gauge is a steel rule installed near shore in the river and is set level with the top of the benchmark at 150 cm. At the end of the season a new benchmark was established because the old benchmark had eroded into the river. The new benchmark is a rebar stake driven into the ground near the camp trail. The new benchmark was calibrated to the old benchmark and represents a water level of 250 cm.

RESULTS

WEIR OPERATIONS

The weir began operation on 24 June and remained in place through 18 September. Breach events occurred several times during the season. A small hole occurred 5 July for approximately 8.5 hours. Scouring under the rail on 23 August and 24 August resulted in a breach event for 15 hours. High water from 11 July through 14 July increased water volume over the boat gate area, resulting in possible missed passage through the area. No passage estimates are included in the total escapement counts.

SALMON ESCAPEMENT

The 2011 observed Chinook salmon escapement through the Middle Fork weir was 1,861 fish. The first Chinook salmon was observed on 25 June and the last Chinook salmon was observed on 18 September. Based on the operational period, the median passage date was 21 July and the central 50% of the run occurred between 11 July and 26 July (Table 1).

Observed sockeye salmon escapement was 17,946 fish. The first sockeye salmon was observed on 24 June and the last sockeye salmon was observed on 19 September. Based on the operational period, the median passage date was 4 July and the central 50% of the run occurred between 30 June and 13 July (Table 1).

Observed chum salmon escapement was 19,974 fish. The first chum salmon was observed on 25 June and the last chum salmon was observed on 16 September. Based on the operational period, the median passage date was 24 July and the central 50% of the run occurred between 19 July and 28 July (Table 1).

Observed coho salmon escapement was 23,826 fish. The first coho salmon was observed on 26 July and the last coho salmon was observed on 18 September. Based on the operational period, the median passage date was 1 September and the central 50% of the run occurred between 27 August and 9 September (Table 1).

Observed passage of pink salmon was 1,394 fish. The first pink salmon was observed on 5 July and the last pink salmon was observed on 18 September. The median passage date was 27 July and the central 50% of the run occurred between 21 July and 10 August (Table 2).

Observed passage of Dolly Varden was 3,667 fish. The first Dolly Varden was observed on 29 June and the last Dolly Varden was observed on 17 September. The median passage date was 23 July and the central 50% of the run occurred between 19 July and 27 July. Observed passage of resident species in 2011 was 395 rainbow trout, 403 whitefish, and 4 Arctic grayling (Table 2).

AGE, SEX, AND LENGTH COMPOSITION ESTIMATES

Sample sizes and distribution of samples were sufficient for estimating sockeye, chum, and coho salmon age, sex, and length composition of the escapement. The sample size for Chinook salmon was insufficient for estimating age, sex, and length composition of the escapement.

Age was determined for 44 Chinook salmon in 2011. Overall, 95% confidence intervals for age composition of annual escapement were no wider than ±14.2%. Age-1.3 Chinook salmon were the most abundant age class in the samples (36.4%), followed by age-1.2 (31.8%), age-1.4 (31.8%). Females comprised 34.1% of the aged samples. Mean male length of the samples was 578 mm for age-1.2 fish and 717 mm for age-1.3. Mean female length of the samples was 721 mm for age-1.3, and 835 mm for age-1.4 fish (Table 3).

Age was determined for 440 sockeye salmon in 2011. Overall, 95% confidence intervals for age composition of annual escapement were no wider than ±2.3%. Age-1.3 sockeye salmon were the most abundant age class (84.1%), followed by age-1.2 (6.4%), and age-1.4 (3.9%). Females comprised 56.1% of the aged samples. Mean male length was 505 mm for age-1.2 fish, 573 mm for age-1.3, and 582 mm for age-1.4. Mean female length was 480 mm for age-1.2 fish, 538 mm for age-1.3, and 537 mm for age-1.4 (Table 4).

Age was determined for 447 chum salmon in 2011. Overall, 95% confidence intervals for age composition of annual escapement were no wider than ±4.7%. Age-0.4 chum salmon was the most abundant age class (52.6%), followed by age-0.3 (44.2%). Females comprised 43.0% of the aged samples. Mean male length was 585 mm for age-0.3 fish and 592 mm for age-0.4 fish. Mean female length was 547 mm for age-0.3 fish and 556 mm for age-0.4 fish (Table 5).

Age was determined for 251 coho salmon in 2011. Overall, 95% confidence intervals for age composition of annual escapement were no wider than ±5.5%. Age-2.1 coho salmon was the most abundant age class (72.9%), followed by age-1.1 (21.1%). Females comprised 41.8% of aged samples. Mean male length of the samples was 580 mm for age-1.1 fish and 597 mm for age-2.1 fish. Mean female length of the samples was 584 mm for age-1.1 fish and 592 mm for age-2.1 fish (Table 6).

ATMOSPHERIC AND HYDROLOGICAL MONITORING

Atmospheric and hydrological observations were recorded daily from 18 June through 19 September. Air temperatures ranged from 0° to 13°C. Water temperature ranged from 5° to 11°C. Several rain events resulted in daily accumulations from trace amounts up to 17 mm for a 24 hour period. Total rainfall during this period was 195 mm. Water levels ranged from 45 to 86 cm (Table 7).

DISCUSSION

WEIR OPERATIONS

The 2011 weir operation was successful in estimating escapement and run timing of Chinook, sockeye, chum, and coho salmon and Dolly Varden past the weir. The majority of project objectives were achieved with the exception of Chinook salmon ASL sampling objective. The project continues to add to the long-term escapement, run timing, and ASL database for salmon returning to Goodnews River and serves as a platform to study other anadromous and resident freshwater species.

ESCAPEMENT MONITORING AND ESTIMATES

The 2011 Chinook salmon escapement at the weir was within the BEG range of 1,500 to 2,900; however, it was below the recent 10-year average (2001–2010) and second lowest among recorded years with similar monitoring methods (Figure 3; Appendix A). Low Chinook salmon escapement estimates were also reported along the Kuskokwim River (C. Brazil, Commercial Fishery Biologist, ADF&G, Anchorage; personal communication). The 50% point of the run passed 9 days later than the median passage date for 1998–2010 Chinook salmon have returned between 6 and 10 days later than the median passage date since 2006 (Figure 4).

The 2011 sockeye salmon escapement at the weir was slightly below the BEG range of 18,000 to 40,000 and the lowest on record among years with similar monitoring methods. The escapement was less than half of the recent 10-year average (2001–2010; Figure 3; Appendix A). Early in the run, daily escapements were near average, but on 4 July daily escapements fell well below average and continued to stay below average for the remainder of the run. These observed escapements resulted in a closure of the District 5 commercial fishery from 13 July to 28 July due to concerns for sockeye salmon. This abnormal run pattern resulted in 50% of the run passing about 4 days earlier than the median passage date (1998–2010; Figure 4).

The 2011 chum salmon escapement at the weir was well above the SEG lower bound of 12,000, but well below the recent 10-year average (2001–2010) and the second lowest escapement since 2001 (Figure 3; Appendix A). The run timing was late as 50% of the run passed about 6 days later than the median passage date (1998–2010; Figure 5). The run timing was potentially affected by the closure of District 5 in July because the early portion of the run was commercially harvested while the later portion of the run was not.

The 2011 coho salmon escapement was well above the SEG lower bound of 12,000. The weir operated until 18 September, which is before the end of the coho salmon migration, but considered to be a reasonable time period for an index of total passage. This is considered reasonable because the cumulative passage during the last 2 days of operation was less than one percent of the total observed passage. The run timing was average (Figure 5).

Passage estimates were not included in the total escapements. Breach areas were small and occurred in areas of low activity. Due to low overall passage it was determined that missed passage would not have a significant effect on overall run timing results.

Dolly Varden counts generated by the weir project represent an unknown proportion of the overall Dolly Varden migration within Middle Fork Goodnews River and should be considered an index. The current spacing between weir panel pickets was chosen for optimal weir operations during high water events and for generating escapement counts of Chinook, sockeye, chum, and coho salmon. Therefore, the weir count must be considered to be size selective for larger (>400 mm) Dolly Varden and probably does not well represent the younger, smaller fish that can pass through the weir unobserved (Lisac 2007). The 2011 Dolly Varden count was the second highest count recorded above the average count of 2,599 and the third highest count recorded since 1996 (Figure 6; Appendix A).

AGE, SEX, AND LENGTH COMPOSITION ESTIMATES

Achieving Chinook salmon ASL sampling objectives continues to be problematic. Low daily passage, migration patterns, and behavior at the weir have made sample collection difficult. Chinook salmon tend to migrate in large pulses so that their passage may be slow for a period of days and then suddenly peak. Coordinating ASL sampling to coincide with these pulses is difficult because timing of the pulses cannot be accurately predicted. An active sampling strategy of capturing Chinook salmon individually or in small groups as other species are allowed to pass freely through the trap has improved sample sizes, but the fish trap used at the weir does not present the best platform for active sampling. This strategy can work well, but is time intensive and Chinook salmon are often hesitant to approach the trap in its current fixed location and when there is increased activity around the trap. In an effort to achieve Chinook salmon sample objectives, active sampling will continue to be conducted at the weir.

The sample size objective was not achieved for individual strata during the sockeye salmon run, but it was sufficient to show there was no meaningful difference in ASL composition over time and to estimate the age composition of the total escapement. The age composition was typical for Middle Fork Goodnews River sockeye salmon with age-1.3 as the most dominant age class followed by age-1.2 and age-1.4, although the age-1.2 contribution was less than observed in past years (Elison and Taylor 2011).

A proportional sample was attempted for sampling chum salmon, but actual sampling resulted in two sample "pulses" that were taken over a five to seven day period and separated by a 14 day

period. ASL composition in these "pulses" were not similar and therefore, the escapement was split into strata based on sample timing and weighted according to the escapement in each stratum. The sample size objectives were not met, but precision criteria for estimating the age composition of the run were met. The age composition was typical for chum salmon with age-0.4 and age-0.3 as the most dominant age classes, but the age-0.3 contribution was less than observed in previous years and the age-0.4 contribution was more dominant (Elison and Taylor 2011).

The sample size objective was met for coho salmon, ASL composition among the three strata was similar, and precision criteria were met. Therefore, all samples were combined and applied to the escapement. Age-2.1 was the most dominant age class, which is typical, but age-1.1 had a much higher relative contribution than observed in past years (Elison and Taylor 2011).

RECOMMENDATIONS

Annual operation of the Middle Fork Goodnews River weir should continue indefinitely. As the only ground-based monitoring project in District W-5, the project provides valuable, reliable inseason and postseason information about Chinook, sockeye, chum, and coho salmon that are critical for sustainable salmon management.

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TABLES AND FIGURES

Table 1.–Daily, cumulative and cumulative percent passage of Chinook, sockeye, chum, and coho salmon, Middle Fork Goodnews River weir, 2011.

	Chinook			Sockeye			Chum			Coho		
Date	Daily	Cum.	% passage	Daily	Cum.	% passage	Daily	Cum.	% passage	Daily	Cum.	% passage
6/24	0	0	0	3	3	0	0	0	0	0	0	0
6/25	1	1	0	645	648	4	12	12	0	0	0	0
6/26	9	10	1	769	1,417	8	14	26	0	0	0	0
6/27	4	14	1	576	1,993	11	24	50	0	0	0	0
6/28	4	18	1	445	2,438	14	7	57	0	0	0	0
6/29	28	46	2	1,155	3,593	20	68	125	1	0	0	0
6/30	15	61	3	1,114	4,707	26	97	222	1	0	0	0
7/01	16	77	4	1,165	5,872	33	158	380	2	0	0	0
7/02	10	87	5	706	6,578	37	53	433	2	0	0	0
7/03	15	102	5	1,892	8,470	47	204	637	3	0	0	0
7/04	11	113	6	442	8,912	**50**	68	705	4	0	0	0
7/05	2 [a]	115	6	274 [a]	9,186	51	103 [a]	808	4	0	0	0
7/06	5	120	6	674	9,860	55	56	864	4	0	0	0
7/07	10	130	7	1,116	10,976	61	196	1,060	5	0	0	0
7/08	23	153	8	531	11,507	64	260	1,320	7	0	0	0
7/09	160	313	17	1,007	12,514	70	194	1,514	8	0	0	0
7/10	73	386	21	499	13,013	73	377	1,891	9	0	0	0
7/11	90 [a]	476	26	83 [a]	13,096	73	70 [a]	1,961	10	0	0	0
7/12	21 [a]	497	27	143 [a]	13,239	74	52 [a]	2,013	10	0	0	0
7/13	15 [a]	512	28	356 [a]	13,595	76	100 [a]	2,113	11	0	0	0
7/14	32 [a]	544	29	449 [a]	14,044	78	326 [a]	2,439	12	0	0	0
7/15	18	562	30	268	14,312	80	242	2,681	13	0	0	0
7/16	46	608	33	367	14,679	82	338	3,019	15	0	0	0
7/17	49	657	35	305	14,984	83	544	3,563	18	0	0	0
7/18	42	699	38	261	15,245	85	383	3,946	20	0	0	0
7/19	39	738	40	330	15,575	87	1,092	5,038	25	0	0	0
7/20	121	859	46	232	15,807	88	709	5,747	29	0	0	0
7/21	67	926	**50**	183	15,990	89	1,094	6,841	34	0	0	0
7/22	169	1,095	59	220	16,210	90	1,683	8,524	43	0	0	0
7/23	81	1,176	63	107	16,317	91	1,058	9,582	48	0	0	0
7/24	129	1,305	70	186	16,503	92	1,483	11,065	**55**	0	0	0
7/25	54	1,359	73	115	16,618	93	1,010	12,075	60	0	0	0
7/26	79	1,438	77	94	16,712	93	922	12,997	65	1	1	0
7/27	58	1,496	80	73	16,785	94	1,547	14,544	73	31	32	0
7/28	11	1,507	81	49	16,834	94	1,164	15,708	79	19	51	0
7/29	66	1,573	85	34	16,868	94	277	15,985	80	0	51	0
7/30	23	1,596	86	22	16,890	94	27	16,012	80	2	53	0
7/31	17	1,613	87	7	16,897	94	44	16,056	80	7	60	0
8/01	31	1,644	88	15	16,912	94	119	16,175	81	29	89	0
8/02	19	1,663	89	25	16,937	94	236	16,411	82	19	108	0
8/03	15	1,678	90	17	16,954	94	260	16,671	83	16	124	1
8/04	13	1,691	91	17	16,971	95	234	16,905	85	33	157	1

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Table 1.–Page 2 of 3.

	Chinook			Sockeye			Chum			Coho		
Date	Daily	Cum.	% passage	Daily	Cum.	% passage	Daily	Cum.	% passage	Daily	Cum.	% passage
8/05	20	1,711	92	48	17,019	95	226	17,131	86	26	183	1
8/06	17	1,728	93	28	17,047	95	242	17,373	87	27	210	1
8/07	5	1,733	93	26	17,073	95	165	17,538	88	47	257	1
8/08	3	1,736	93	30	17,103	95	209	17,747	89	42	299	1
8/09	29	1,765	95	51	17,154	96	472	18,219	91	294	593	2
8/10	30	1,795	96	72	17,226	96	219	18,438	92	157	750	3
8/11	12	1,807	97	46	17,272	96	357	18,795	94	85	835	4
8/12	6	1,813	97	44	17,316	96	397	19,192	96	101	936	4
8/13	0	1,813	97	14	17,330	97	85	19,277	97	84	1,020	4
8/14	10	1,823	98	52	17,382	97	154	19,431	97	110	1,130	5
8/15	2	1,825	98	30	17,412	97	78	19,509	98	45	1,175	5
8/16	4	1,829	98	28	17,440	97	130	19,639	98	168	1,343	6
8/17	2	1,831	98	61	17,501	98	107	19,746	99	224	1,567	7
8/18	2	1,833	98	14	17,515	98	51	19,797	99	273	1,840	8
8/19	0	1,833	98	30	17,545	98	49	19,846	99	838	2,678	11
8/20	0	1,833	98	33	17,578	98	29	19,875	100	478	3,156	13
8/21	3	1,836	99	28	17,606	98	18	19,893	100	402	3,558	15
8/22	0[a]	1,836	99	10[a]	17,616	98	14[a]	19,907	100	251[a]	3,809	16
8/23	0[a]	1,836	99	10[a]	17,626	98	7[a]	19,914	100	126[a]	3,935	17
8/24	3	1,839	99	24	17,650	98	19	19,933	100	477	4,412	19
8/25	4	1,843	99	30	17,680	99	6	19,939	100	258	4,670	20
8/26	5	1,848	99	32	17,712	99	8	19,947	100	714	5,384	23
8/27	4	1,852	100	19	17,731	99	6	19,953	100	961	6,345	27
8/28	3	1,855	100	23	17,754	99	2	19,955	100	1,010	7,355	31
8/29	1	1,856	100	22	17,776	99	2	19,957	100	803	8,158	34
8/30	1	1,857	100	11	17,787	99	9	19,966	100	1,217	9,375	39
8/31	0	1,857	100	16	17,803	99	2	19,968	100	1,966	11,341	48
9/01	0	1,857	100	31	17,834	99	1	19,969	100	1,050	12,391	**52**
9/02	2	1,859	100	17	17,851	99	0	19,969	100	956	13,347	56
9/03	0	1,859	100	11	17,862	100	1	19,970	100	753	14,100	59
9/04	0	1,859	100	3	17,865	100	0	19,970	100	683	14,783	62
9/05	0	1,859	100	13	17,878	100	0	19,970	100	637	15,420	65
9/06	0	1,859	100	8	17,886	100	2	19,972	100	727	16,147	68
9/07	0	1,859	100	3	17,889	100	0	19,972	100	369	16,516	69
9/08	0	1,859	100	9	17,898	100	0	19,972	100	1,076	17,592	74
9/09	0	1,859	100	0	17,898	100	0	19,972	100	588	18,180	76

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Table 1.–Page 3 of 3.

	Chinook			Sockeye			Chum			Coho		
Date	Daily	Cum.	% passage	Daily	Cum.	% passage	Daily	Cum.	% passage	Daily	Cum.	% passage
9/10	0	1,859	100	3	17,901	100	0	19,972	100	678	18,858	79
9/11	0	1,859	100	8	17,909	100	0	19,972	100	656	19,514	82
9/12	0	1,859	100	4	17,913	100	0	19,972	100	399	19,913	84
9/13	0	1,859	100	2	17,915	100	0	19,972	100	1,357	21,270	89
9/14	1	1,860	100	5	17,920	100	0	19,972	100	773	22,043	93
9/15	0	1,860	100	10	17,930	100	0	19,972	100	979	23,022	97
9/16	0	1,860	100	5	17,935	100	2	19,974	100	505	23,527	99
9/17	0	1,860	100	6	17,941	100	0	19,974	100	123	23,650	99
9/18	1	1,861	100	5	17,946	100	0	19,974	100	176	23,826	100
Total	1,861			17,946			19,974			23,826		
Observed	1,861			17,946			19,974			23,826		
Estimated												
% Observed	100			100			100			100		

Note: Outside boxes indicate 80% of the run, inside boxes indicate the estimated central 50% of passage and the bold box indicates the date that the estimated cumulative 50% passage occurred.

[a] Partial count, a breach occurred in the weir; missed passage was not estimated.

Table 2.–Daily and cumulative and cumulative percent passage of pink salmon and Dolly Varden, whitefish, rainbow trout and Arctic grayling, Middle Fork Goodnews 2011.

	Pink Salmon			Dolly Varden			Whitefish		Rainbow Trout		Arctic Grayling	
Date	Daily	Cum.	% passage	Daily	Cum.	% passage	Daily	Cum.	Daily	Cum.	Daily	Cum.
6/24	0	0	0	0	0	0	0	0	0	0	0	0
6/25	0	0	0	0	0	0	1	1	2	2	0	0
6/26	0	0	0	0	0	0	3	4	1	3	0	0
6/27	0	0	0	0	0	0	0	4	0	3	0	0
6/28	0	0	0	0	0	0	3	7	1	4	0	0
6/29	0	0	0	1	1	0	1	8	0	4	0	0
6/30	0	0	0	3	4	0	4	12	0	4	0	0
7/01	0	0	0	8	12	0	11	23	2	6	0	0
7/02	0	0	0	5	17	0	2	25	0	6	0	0
7/03	0	0	0	2	19	1	5	30	2	8	2	2
7/04	0	0	0	1	20	1	0	30	2	10	0	2
7/05	1 [a]	1	0	7 [a]	27	1	0 [a]	30	2 [a]	12	0 [a]	2
7/06	6	7	1	3	30	1	3	33	0	12	0	2
7/07	4	11	1	10	40	1	13	46	2	14	0	2
7/08	4	15	1	7	47	1	12	58	1	15	0	2
7/09	13	28	2	13	60	2	7	65	1	16	0	2
7/10	11	39	3	19	79	2	0	65	9	25	0	2
7/11	7	46	3	17	96	3	2	67	4	29	0	2
7/12	0	46	3	13	109	3	0	67	3	32	0	2
7/13	7	53	4	52	161	4	3	70	2	34	0	2
7/14	21	74	5	45	206	6	2	72	2	36	0	2
7/15	29	103	7	42	248	7	4	76	2	38	0	2
7/16	28	131	9	171	419	11	2	78	0	38	0	2
7/17	37	168	12	69	488	13	1	79	0	38	0	2
7/18	19	187	13	126	614	17	1	80	1	39	0	2
7/19	53	240	17	329	943	26	2	82	11	50	0	2
7/20	76	316	23	135	1,078	29	2	84	8	58	0	2
7/21	48	364	26	237	1,315	36	10	94	9	67	0	2
7/22	105	469	34	313	1,628	44	13	107	13	80	0	2
7/23	74	543	39	258	1,886	**51**	17	124	6	86	0	2
7/24	55	598	43	262	2,148	59	14	138	15	101	0	2
7/25	42	640	46	213	2,361	64	12	150	11	112	0	2
7/26	30	670	48	109	2,470	67	19	169	40	152	0	2
7/27	49	719	**52**	432	2,902	79	8	177	16	168	0	2
7/28	27	746	54	253	3,155	86	9	186	10	178	0	2
7/29	25	771	55	71	3,226	88	1	187	2	180	0	2
7/30	5	776	56	27	3,253	89	3	190	0	180	0	2
7/31	12	788	57	19	3,272	89	2	192	1	181	0	2
8/01	21	809	58	21	3,293	90	0	192	0	181	0	2
8/02	24	833	60	18	3,311	90	4	196	0	181	0	2
8/03	18	851	61	15	3,326	91	0	196	3	184	0	2
8/04	18	869	62	18	3,344	91	2	198	2	186	0	2
8/05	30	899	64	21	3,365	92	11	209	7	193	0	2
8/06	13	912	65	7	3,372	92	1	210	2	195	0	2
8/07	24	936	67	8	3,380	92	0	210	1	196	0	2
8/08	24	960	69	6	3,386	92	0	210	1	197	0	2
8/09	54	1,014	73	24	3,410	93	1	211	4	201	0	2
8/10	33	1,047	75	10	3,420	93	4	215	11	212	0	2

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Table 2.–Page 2 of 2.

	Pink Salmon			Dolly Varden			Whitefish		Rainbow Trout		Arctic Grayling	
Date	Daily	Cum.		Daily	Cum.		Daily	Cum.	Daily	Cum.	Daily	Cum.
8/11	39	1,086	78	24	3,444	94	0	215	5	217	0	2
8/12	37	1,123	81	12	3,456	94	6	221	8	225	0	2
8/13	9	1,132	81	2	3,458	94	4	225	2	227	0	2
8/14	29	1,161	83	14	3,472	95	5	230	24	251	0	2
8/15	17	1,178	85	10	3,482	95	5	235	17	268	0	2
8/16	18	1,196	86	12	3,494	95	6	241	8	276	0	2
8/17	16	1,212	87	11	3,505	96	8	249	12	288	0	2
8/18	10	1,222	88	19	3,524	96	8	257	11	299	0	2
8/19	9	1,231	88	5	3,529	96	8	265	8	307	0	2
8/20	9	1,240	89	10	3,539	97	9	274	0	307	0	2
8/21	8	1,248	90	4	3,543	97	11	285	9	316	0	2
8/22	2 [a]	1,250	90	8 [a]	3,551	97	10 [a]	295	2 [a]	318	0 [a]	2
8/23	3 [a]	1,253	90	11 [a]	3,562	97	3 [a]	298	1 [a]	319	0 [a]	2
8/24	15	1,268	91	4	3,566	97	7	305	3	322	0	2
8/25	12	1,280	92	12	3,578	98	1	306	1	323	1	3
8/26	12	1,292	93	5	3,583	98	3	309	5	328	0	3
8/27	18	1,310	94	8	3,591	98	10	319	1	329	0	3
8/28	7	1,317	94	10	3,601	98	10	329	2	331	0	3
8/29	7	1,324	95	6	3,607	98	12	341	7	338	0	3
8/30	6	1,330	95	8	3,615	99	7	348	3	341	0	3
8/31	5	1,335	96	9	3,624	99	2	350	4	345	0	3
9/01	2	1,337	96	6	3,630	99	6	356	2	347	0	3
9/02	4	1,341	96	9	3,639	99	7	363	3	350	0	3
9/03	5	1,346	97	1	3,640	99	0	363	1	351	0	3
9/04	5	1,351	97	5	3,645	99	5	368	5	356	0	3
9/05	3	1,354	97	0	3,645	99	1	369	2	358	0	3
9/06	15	1,369	98	3	3,648	99	6	375	1	359	0	3
9/07	2	1,371	98	2	3,650	100	0	375	0	359	0	3
9/08	4	1,375	99	2	3,652	100	4	379	2	361	0	3
9/09	0	1,375	99	3	3,655	100	0	379	6	367	0	3
9/10	2	1,377	99	0	3,655	100	7	386	2	369	0	3
9/11	3	1,380	99	2	3,657	100	0	386	3	372	0	3
9/12	3	1,383	99	1	3,658	100	5	391	0	372	0	3
9/13	2	1,385	99	1	3,659	100	2	393	7	379	0	3
9/14	3	1,388	100	0	3,659	100	1	394	2	381	0	3
9/15	2	1,390	100	2	3,661	100	4	398	4	385	0	3
9/16	0	1,390	100	4	3,665	100	3	401	3	388	1	4
9/17	1	1,391	100	2	3,667	100	1	402	3	391	0	4
9/18	3	1,394	100	0	3,667	100	1	403	4	395	0	4
Total	1,394			3,667			403		395		4	

Note: Outside boxes indicate 80% of the run, inside boxes indicate the estimated central 50% of passage and the bold box indicates the date that the estimated cumulative 50% passage occurred.

[a] Partial day counts because of a breach in weir, no estimates were made.

[b] The weir was not operational; daily passage was not estimated.

Table 3.–Age and sex composition and mean length (mm) of Chinook salmon escapement, Middle Fork Goodnews River weir, 2011.

	Sample Size		Age Class 1.2 N	1.2 %	1.3 N	1.3 %	1.4 N	1.4 %	Total N	Total %
Total [a]	44	Male	14	31.8	14	31.8	1	2.3	29	65.9
		Female	0	0.0	2	4.5	13	29.5	15	34.1
		Total	14	31.8	16	36.4	14	31.8	44	100.0
		95% C.I.		13.7		14.2		13.7		
		Male Mean Length		578		717		678		
		SE		14.51		10.85		-		
		Range		485-676		659-797		678-678		
		n		14		14		1		
		Female Mean Length		-		721		835		
		SE		-		49.50		9.03		
		Range		-		671-770		783-896		
		n		-		2		13		

[a] No meaningful stratification was found, all stratum data was combined.

Table 4.–Age and sex composition and mean length (mm) of sockeye salmon escapement, Middle Fork Goodnews River weir, 2011.

			Age Class																	
Sample			0.3		1.2		0.4		1.3		2.2		1.4		2.3		2.4		Total	
Size			N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%
440		Male	286	1.6	449	2.5	41	0.2	6,730	37.5	0	0.0	204	1.1	122	0.7	41	0.2	7,872	43.9
Total[a]		Female	245	1.4	693	3.9	0	0.0	8,361	46.6	41	0.2	489	2.7	245	1.4	0	0.0	10,074	56.1
		Total	530	3.0	1,142	6.4	41	0.2	15,091	84.1	41	0.2	693	3.9	367	2.0	41	0.2	17,946	100.0
		95% C.I.		1.6		2.3		-		3.4		-		1.8		1.3		-		
		Male Mean Length		578		505		618		573		-		582		555		565		
		SE		8.83		13.03		-		1.43		-		11.72		9.40		-		
		Range		552-621		427-571		618-618		505-632		0-0		558-625		536-566		565-565		
		n		7		11		1		165		-		5		3		1		
		Female Mean Length		549		480		-		538		494		537		540		-		
		SE		6.69		9.10		-		1.47		-		3.71		7.70		-		
		Range		516-559		432-566		0-0		467-591		494-494		518-557		511-558		0-0		
		n		6		17		-		205		1		12		6		-		

[a] Meaningful stratification was not found, data was separated into 3 stratum. Total results are weighted.

Table 5.–Age and sex composition and mean length (mm) of chum salmon escapement, Middle Fork Goodnews River weir, 2011.

	Sample		Age Class									
			0.2		0.3		0.4		0.5		Total	
	Size		N	%	N	%	N	%	N	%	N	%
Total [a]	447	Male	123	0.6	4,835	24.2	6,068	30.4	351	1.8	11,377	57.0
		Female	0	0.0	3,993	20.0	4,445	22.3	159	0.8	8,597	43.0
		Total	123	0.6	8,828	44.2	10,513	52.6	510	2.6	19,974	100.0
		95%C.I.		0.7		4.6		4.7		1.7		
		Male Mean Length		563		585		592		547		
		SE		10.26		2.93		2.17		22.47		
		Range		549-583		515-642		533-650		532-649		
		n		3		111		134		5		
		Female Mean Length		-		547		556		546		
		SE		-		4.57		2.92		6.00		
		Range		0-0		440-620		499-644		539-551		
		n		-		94		97		3		

[a] ASL sample pulses were not similar. The escapement was split into 2 strata based on sample timing and weighted according to the escapement in each stratum.

Table 6.–Age and sex composition and mean length (mm) of coho salmon escapement, Middle Fork Goodnews River weir, 2011.

Sample		Age Class							
		1.1		2.1		3.1		Total	
Size		N	%	N	%	N	%	N	%
251	Male	2,753	11.6	10,442	43.8	664	2.8	13,859	58.2
Total [a]	Female	2,278	9.6	6,929	29.1	759	3.2	9,967	41.8
	Total	5,031	21.1	17,371	72.9	1,424	6.0	23,826	100.0
	95% C.I.		5.0		5.5		2.9		
	Male Mean Length		580		597		606		
	SE		4.97		4.16		10.18		
	Range		527-615		426-684		556-633		
	n		29		110		7		
	Female Mean Length		584		592		592		
	SE		6.38		3.63		7.08		
	Range		484-636		480-662		553-621		
	n		24		73		8		

[a] ASL composition among the 3 strata was similar, and precision criteria were met. All samples were combined and applied to the escapement.

Table 7.–Daily weather and hydrological, Middle Fork Goodnews River weir site, 2011.

Date	Wind (Dir./Speed)	Precipitation mm/24hr	Air Temp. °C	Water Temp °C	Cloud Cover %/altitude (ft)	Water Level (cm)
6/18	calm	0.0	9	7.5	100/1500	66
6/19	calm	0.0	9	7.5	100/1000	62
6/20	calm	0.0	10	8	80/2000	62
6/21	W/5	0.0	8	7	100/2000	60
6/22	W/5	0.0	9	6.5	90/2000	59
6/23	calm	0.0	9	7	100/1500	59
6/24	calm	0.0	8	7	100/1000	59
6/25	calm	0.0	10	7	100/2000	59
6/26	SE/20	0.0	9	7	100/1500	58
6/27	E/5	5.6	9	7	100/1000	57
6/28	calm	7.6	7	7	100/500	61
6/29	calm	0.0	7	5	100/2000	60
6/30	calm	0.0	6	8	fog	59
7/01	calm	0.0	9	9	10/1500	57
7/02	calm	1.3	6	8	80/1500	56
7/03	calm	0.0	12	10	0	54
7/04	calm	0.0	5	9	10\5000	53
7/05	calm	0.0	9	8	0	50
7/06	W/10	0.0	7	9	100/1000	49
7/07	S/10	4.8	9	8	100/1000	52
7/08	W/5	0.0	9	8	100/1000	59
7/09	E/5	3.8	9	8	100/1000	61
7/10	calm	2.5	9	8	100/500	68
7/11	SE/20	13.7	10	9	100/1000	69
7/12	calm	1.3	9	8	100/1500	86
7/13	W/5	0.0	8	8	100/1500	85
7/14	W/15	0.3	7	7	100/500	80
7/15	calm	0.0	8	8	10/500	77
7/16	calm	0.0	10	8	100/1000	73
7/17	calm	5.1	8	10	100/1000	70
7/18	calm	0.0	6	8	80/2000	70
7/19	calm	0.0	6	9	100/1500	66
7/20	calm	3.8	12	11	100/2000	62
7/21	calm	0.0	9	9	100/1000	60
7/22	calm	0.0	8	9	100/1500	59
7/23	SW/10	1.5	10	10	100/500	55
7/24	calm	7.9	8	9	100/500	60
7/25	W/10	2.5	8	9	100/500	61
7/26	W/10	2.5	8	9	100/500	58
7/27	calm	1.3	9	9	100/2000	57
7/28	W/5	0.8	9	10	100/500	57
7/29	calm	0.0	8	10	80/1000	60
7/30	calm	0.0	8	8	100/500	56
7/31	calm	1.0	7	9	100/500	53
8/01	calm	10.2	10	8	100/500	58
8/02	calm	1.3	9	9	100/500	57
8/03	calm	0.0	5	10	0	55
8/04	W/10	5.1	6	9	100/500	53

-continued-

Table 7.–Page 2 of 2.

Date	Wind (Dir./Speed)	Precipitation mm/24hr	Air Temp. °C	Water Temp °C	Cloud Cover %/altitude (ft)	Water Level (cm)
8/05	calm	2.8	5	9	90/3000	57
8/06	S/5	1.3	6	9	100/1000	54
8/07	calm	2.5	6	8	100/500	53
8/08	E/5	6.1	7	9	100/1000	59
8/09	calm	0.8	2	7	fog	60
8/10	calm	0.0	2	7	100/1000	60
8/11	W/5	0.0	9	9	100/2000	58
8/12	W/10	2.0	7	9	100/500	56
8/13	W/15	0.0	13	10	100/1500	54
8/14	W/5	1.3	8	9	100/1000	54
8/15	calm	0.0	6	9	20/2000	51
8/16	calm	0.0	1	10	fog/200	50
8/17	calm	0.0	5	10	fog/200	49
8/18	W/5	0.0	8	10	10\3000	48
8/19	E/5	15.2	7	10	100/1500	50
8/20	calm	17.3	12	10	100/3000	51
8/21	W/15	0.0	13	10	10\3000	50
8/22	W/5	0.0	6	10	100/3000	48
8/23	calm	1.5	2	7	60/2500	45
8/24	S/5	2.5	7	9	100/1500	45
8/25	calm	2.3	0	9	fog	48
8/26	calm	0.0	2	8	70/2000	47
8/27	calm	3.0	8	9	50/3000	46
8/28	calm	0.0	6	9	100/2000	46
8/29	E/5	0.0	8	9	100/1500	45
8/30	E/5	2.8	7	9	100/1000	45
8/31	calm	4.8	8	9	100/1500	54
9/01	calm	2.3	7	9	100/1000	58
9/02	E/5	2.8	7	8	80/2000	55
9/03	calm	0.0	7	9	100/1500	54
9/04	calm	2.8	8	9	100/1000	53
9/05	calm	1.5	7	8	60/2000	53
9/06	calm	0.0	8	8	100/1500	52
9/07	calm	1.5	8	9	100/1000	50
9/08	calm	3.6	8	8	100/1000	51
9/09	calm	0.0	7	8	100/1000	50
9/10	calm	0.0	6	8	100/1500	48
9/11	E/10	0.0	7	9	100/1500	47
9/12	calm	0.0	9	9	100/1000	46
9/13	calm	5.3	8	9	100/2000	51
9/14	E/5	13.7	9	9	100/1500	52
9/15	E/5	7.6	10	9	80/1500	54
9/16	calm	0.0	9	8	90/2500	61
9/17	calm	3.8	6	8	20/2000	60
9/18	calm	0.0	9	8	80/2000	59
9/19	calm	0.0	1	7	10\3000	57
Min		0.0	0	5		45
Max		17.3	13	11		86
Average		2.1	8	9		57

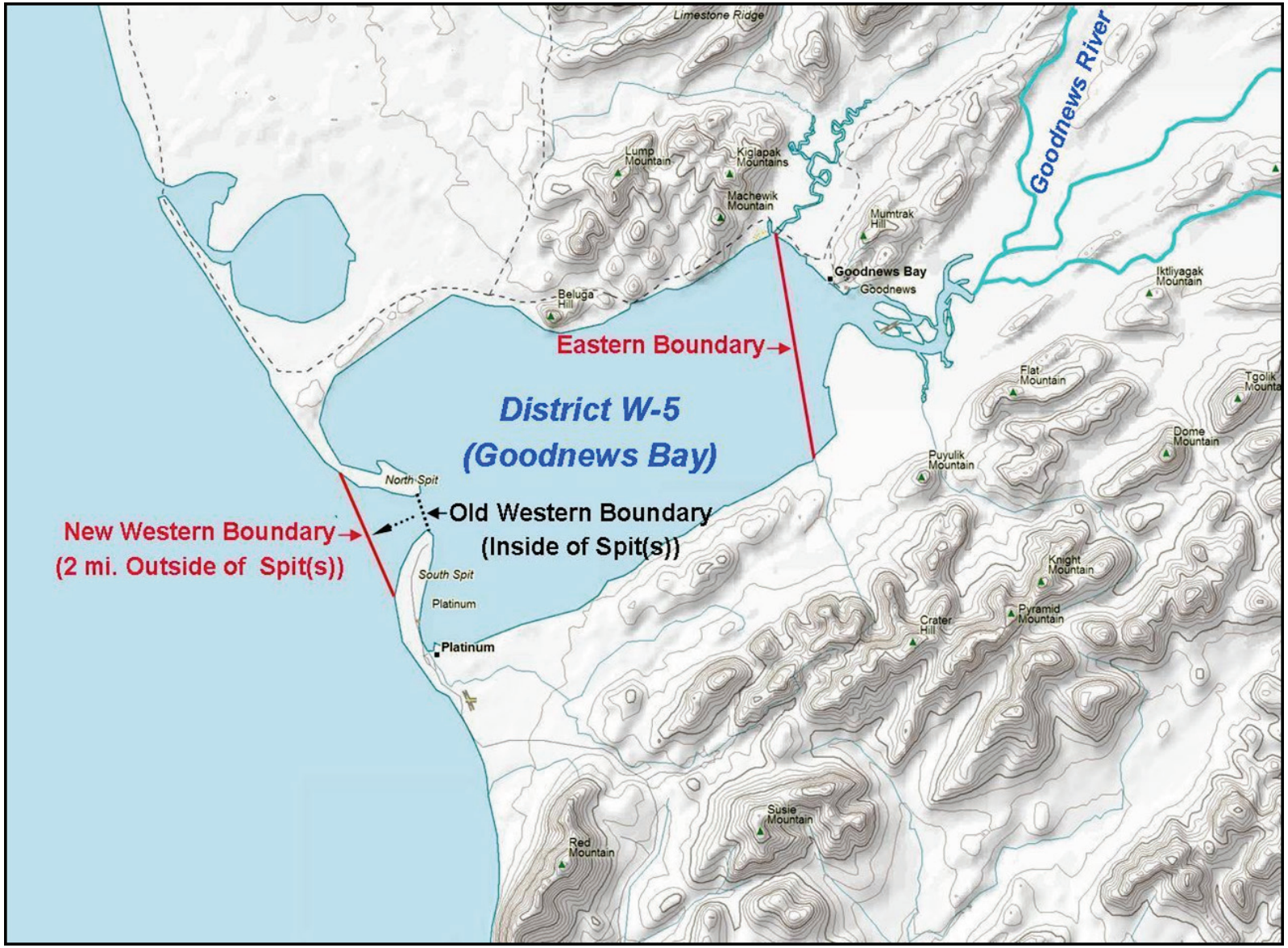


Figure 1.–Commercial fishing District W-5 (Goodnews Bay), Kuskokwim Bay, Alaska.

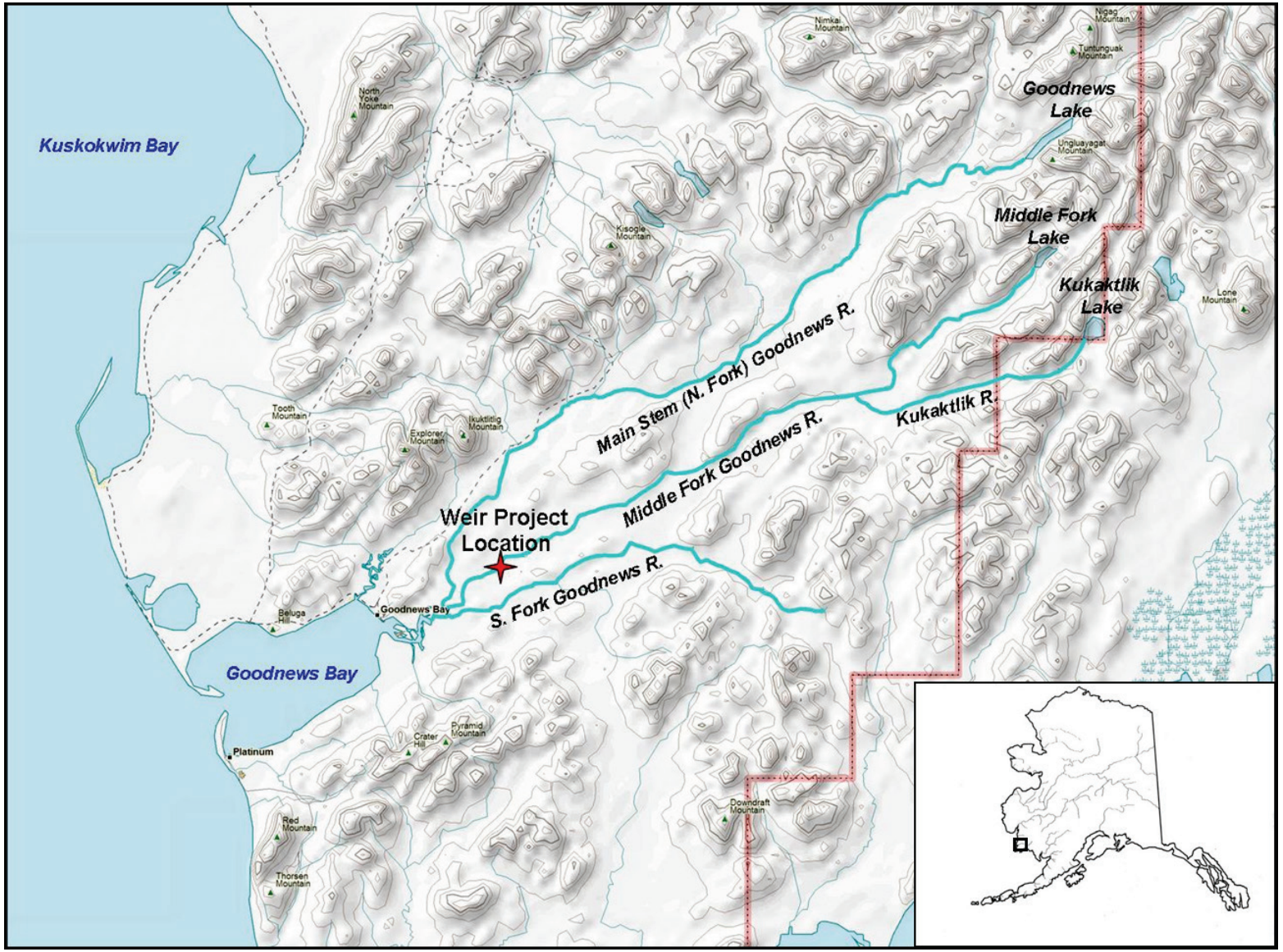


Figure 2.–Goodnews River Drainage, Kuskokwim Bay, Alaska.

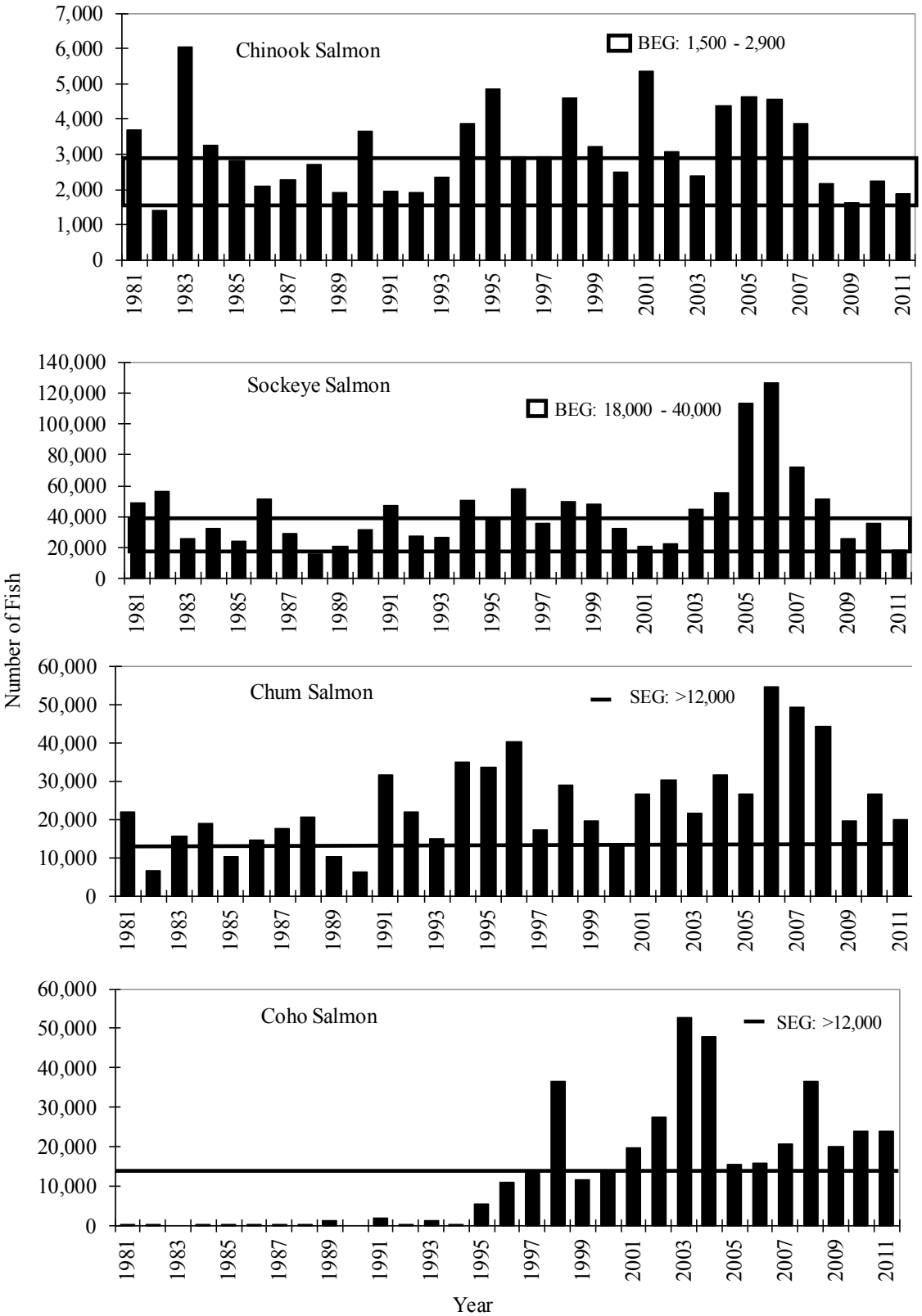
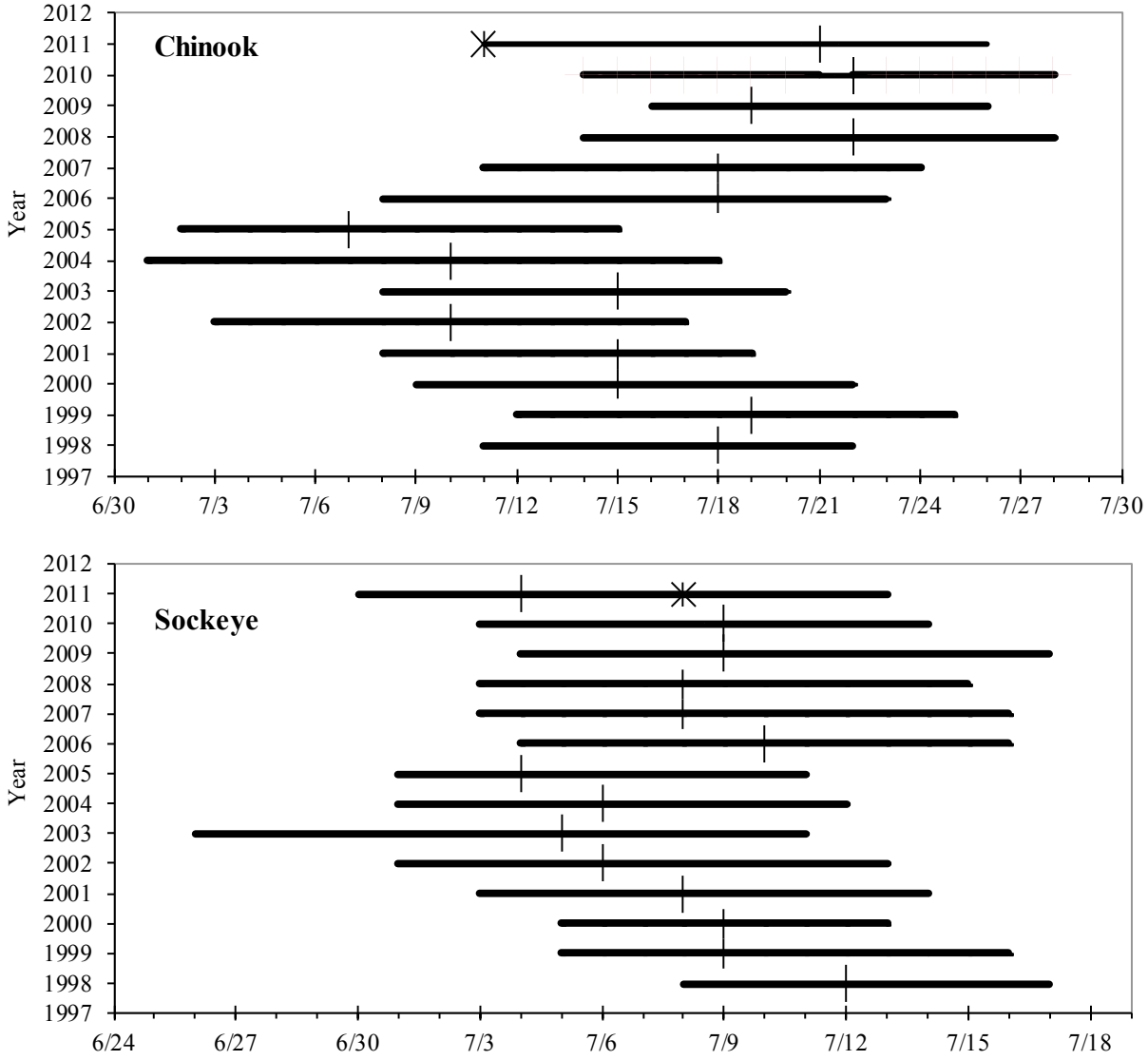
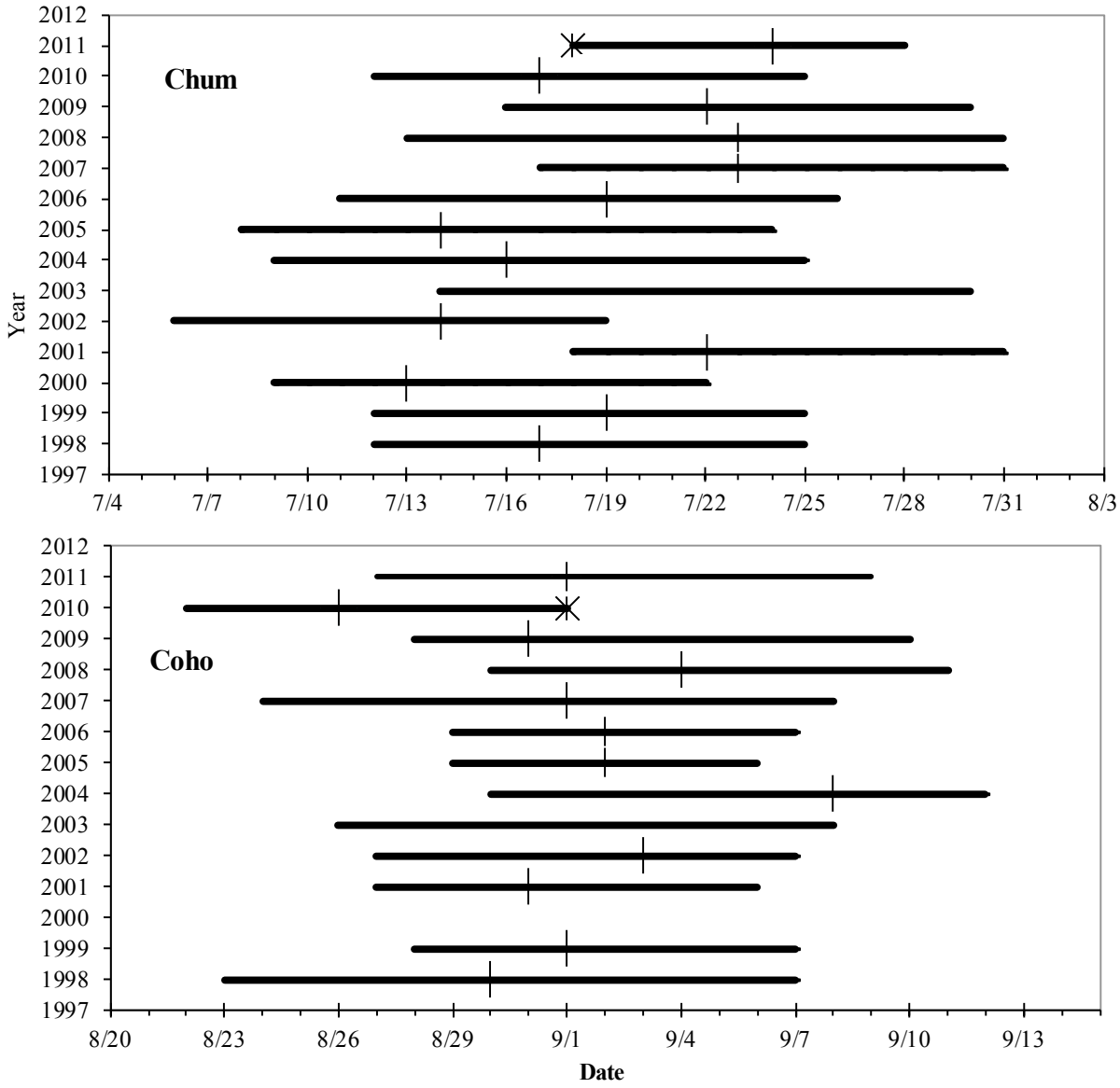


Figure 3.–Historical Chinook, sockeye, chum, and coho salmon escapement estimates, Middle Fork Goodnews River weir, 1981–2011.



Note: Solid lines represent the dates when the central 50% of the run passed, cross-bars represent the median passage date and asterisk marks represent historic median (1998–2010).

Figure 4.–Annual run timing of Chinook and sockeye salmon based on cumulative percent passage at the Middle Fork Goodnews River weir, 1998–2011.



Note: Solid lines represent the dates when the central 50% of the run passed, cross-bars represent the median passage date and asterisk marks represent historic median (1998–2010).

Figure 5.–Annual run timing of chum and coho salmon based on cumulative percent passage at the Middle Fork Goodnews River weir, 1998–2011.

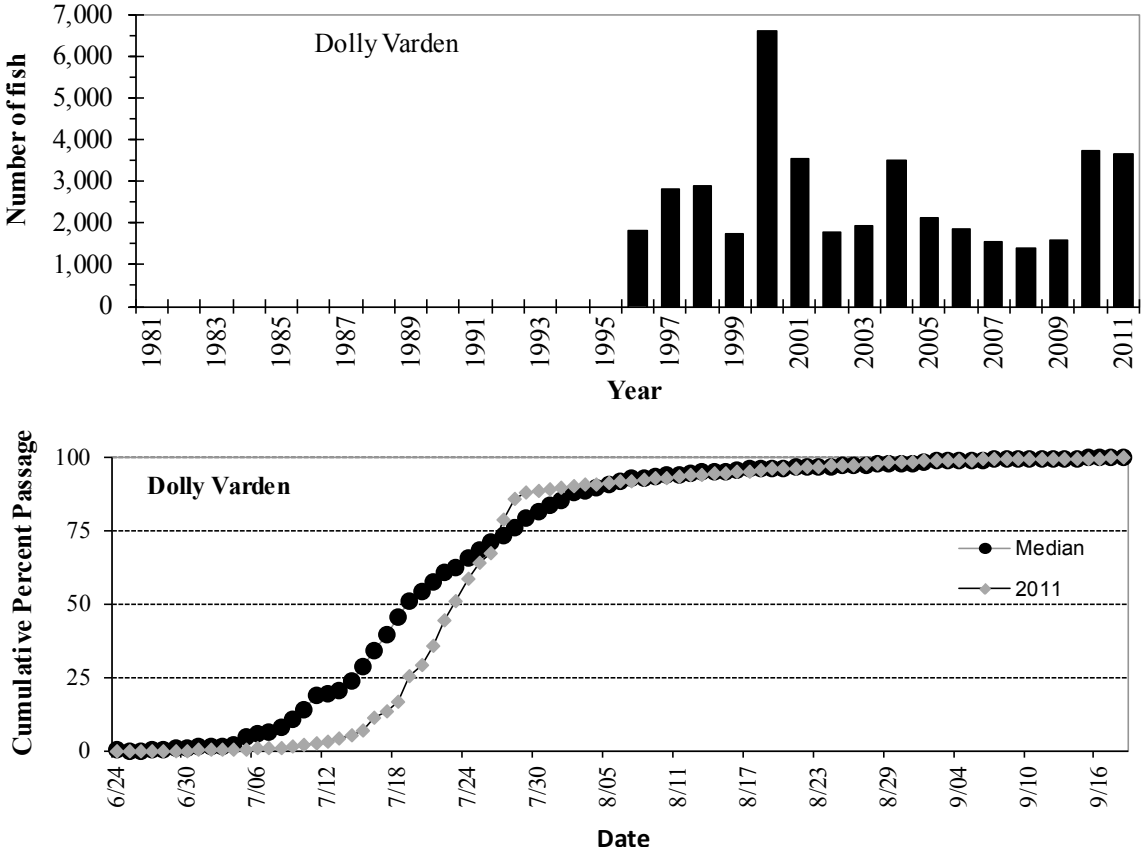


Figure 6.–Historical Dolly Varden escapement estimate, 1981–2011, and cumulative percent passage of Dolly Varden, 2011 and historical median, at Middle Fork Goodnews River weir.

APPENDIX A: HISTORICAL ESCAPEMENT

Appendix A1.–Historical escapement, Middle Fork Goodnews River escapement projects, 1981–2011.

Year	Method	Dates of Operation	Chinook	Sockeye	Chum	Pink[a]	Coho	Dolly Varden
1981	Counting Tower[b]	6/13 - 8/9	3,688	49,108	21,827	[c]	356[d]	[c]
1982	Counting Tower[b]	6/23 - 8/3	1,395	56,255	6,767	[c]	91[d]	[c]
1983	Counting Tower[b]	6/11 - 7/28	6,027	25,816	15,548	[c]	0[d]	[c]
1984	Counting Tower[b]	6/15 - 7/31	3,260	32,053	19,003	[c]	249[d]	[c]
1985	Counting Tower[b]	6/27 - 7/31	2,831	24,131	10,367	[c]	282[d]	[c]
1986	Counting Tower[b]	6/16 - 7/24	2,080	51,069	14,764	[c]	163[d]	[c]
1987	Counting Tower[b]	6/22 - 7/30	2,272	28,871	17,517	[c]	62[d]	[c]
1988	Counting Tower[b]	6/23 - 7/30	2,712	15,799	20,799	[c]	6[d]	[c]
1989	Counting Tower[b]	6/27 - 7/31	1,915	21,186	10,380	[c]	1,212[d]	[c]
1990	Counting Tower[b]	6/20-7/31	3,636	31,679	6,410	[c]	0[d]	[c]
1991	Fixed Picket Weir[e]	6/29 - 8/23	1,952	47,397	31,644	1,428	1,978[d]	[c]
1992	Fixed Picket Weir[e]	6/21 - 8/4	1,905	27,268	22,023	22,601	150[d]	[c]
1993	Fixed Picket Weir[e]	6/23 - 8/18	2,349	26,452	14,952	318	1,451[d]	[c]
1994	Fixed Picket Weir[e]	6/23 - 8/9	3,856	50,801	34,849	38,705	309[d]	[c]
1995	Fixed Picket Weir[e]	6/19 - 8/28	4,836	39,009	33,699	330	5,415[d]	[c]
1996	Fixed Picket Weir[e]	6/19 - 8/23	2,931	58,290	40,450	20,105	10,869[d]	1,829[d]
1997	Fixed/R. Board Weir	6/12 - 9/17	2,937	35,530	17,369	940	13,413	2,808
1998	R. Board Weir	7/4 - 9/17	4,584[d]	49,513[d]	28,832[d]	10,376	36,596	2,915
1999	R. Board Weir	6/25 - 9/26	3,221	48,205	19,513	914	11,545	1,761
2000	R. Board Weir	7/2 - 8/27	2,500[d]	32,341[d]	13,791[d]	0	13,907	6,616
2001	R. Board Weir	6/26 - 9/30	5,351	21,024	26,820	5,405	19,626	3,535
2002	R. Board Weir	6/25 - 9/18	3,085	22,101	30,300	0	27,364	1,770
2003	R. Board Weir	6/18 - 9/18	2,389	44,387	21,637	1,921	52,810	1,949
2004	R. Board Weir	6/21 - 9/20	4,388	55,926	31,616	21,633	47,917	3,492
2005	R. Board Weir	6/26 - 9/8	4,633	113,809	26,690	5,926	15,683	2,128
2006	R. Board Weir	6/26 - 9/7	4,559	126,772	54,699	18,432	15,969	1,858
2007	R. Board Weir	6/25 - 9/10	3,852	72,282	49,285	4,819	20,767	1,549
2008	R. Board Weir	7/02-9/15	2,158	51,763	44,310	9,807	36,663	1,416
2009	R. Board Weir	6/28-9/21	1,630	25,465	19,715	714	20,000	1,608
2010	R. Board Weir	6/25-9/18	2,244	35,762	26,687	3,444	23,839	3,757
2011	R. Board Weir	6/25-9/19	1,861	17,946	19,974	1,394	23,826	3,667
10-year average (2001-2011)			3,429	56,929	33,176	7,210	28,064	2,306
Historical Average			3,173	44,002	24,409	8,391	12,623	2,599

[a] Picket spacing of the weir panels allows pink salmon to freely pass through the weir unobserved.

[b] Project located approximately 500 yards upriver from current weir location.

[c] Species not enumerated during project operations.

[d] No counts or incomplete counts as the project was not operational during a large portion of species migration.

[e] Fixed picket weir operated in the same location as the current weir.